Lloyd's Register

Rules and Regulations for the Classification of Special Service Craft, July 2011

Notice No. 4

Effective Date of Latest Amendments:

See page 1

Issue date: May 2012

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RULES AND REGULATIONS FOR THE CLASSIFICATION OF SPECIAL SERVICE CRAFT, *July 2011*

Notice No. 4

This Notice contains amendments within the following Sections of the *Rules and Regulations for the Classification of Special Service Craft, July 2011.* The amendments are effective on the dates shown:

Part	***Chapter***	***Section***	***Effective date***
1	2	1, 3	1 July 2012
3	2	6, 8, 9	1 July 2012
3	3	1, 2	1 July 2012
3	4	7, 11	1 July 2012
3	5	3, 6	1 July 2012
4	2	8, 9	1 July 2012
4	3	1, 5	1 July 2012
5	2	2	1 July 2012
5	3	2	1 July 2012
5	4	2	1 July 2012
5	5	2, 3, 4	1 July 2012
6	4	7	1 July 2012
6	5	3, 6, 7	1 July 2012
7	2	2	1 July 2012
7	4	7	1 July 2012
7	5	6, 7	1 July 2012
8	2	1, 2, 3, 4, 5	1 July 2012
8	3	1, 2, 3, 4, 5, 6, 7, 8, 9	1 July 2012
8	4	2, 3, 5, 6, 8	1 July 2012
8	5	2, 3, 6	1 July 2012
16	2	11	1 July 2012

It will be noted that the amendments also include corrigenda, which are effective from the date of this Notice.

The *Rules and Regulations for the Classification of Special Service Craft, July 2011* are to be read in conjunction with this Notice No. 4. The status of the Rules is now:

Rules for Special Service Craft	Effective date:	July 2011
Notice No. 1	Effective date:	1 January 2012
Notice No. 2	Effective date:	1 January 2012
Notice No. 3	Effective date:	1 January 2012
Notice No. 4	Effective date:	1 July 2012

Volume 1, Part 1, Chapter 2

Classification Regulations

Effective date 1 July, 2012

Section 1
Conditions for classification

1.1 General

1.1.13 Yachts with a load line length, of 24 m and over, having a service type notation of **Yacht**, will be assigned class only after it has been demonstrated that the stability of the yacht complies with the stability requirements of ~~the UK MCA's Large Commercial Yacht Code or of the requirements of~~ the National Administration, provided these are as a minimum equivalent to the intact stability requirements of the UK MCA LY2 Code (as amended).

1.1.14 Yachts with a load line length ~~between~~ of 24 m~~, and 85 m~~ and above, and with a gross tonnage of less than 3000, will be assigned a service type notation **Yacht(S**) only after it has been demonstrated that both the intact and damage stability ~~complies~~ with the UK MCA LY2 Code comply~~. for multi-hulls and sailing vessels and the IMO IS 2008 Code for mono hull motor vessels (as amended) Damage stability is to be in compliance with the UK MCA LY2 Code~~ (as amended). ~~Alternative requirements may be acceptable, subject to acceptance by LR.~~

1.1.15 Yachts with a load line length of ~~85~~ 24 m and above ~~or~~, and with a gross tonnage of 3000 and above, will be assigned a service type notation **Yacht(S)** only after it has been demonstrated that both the intact and damage stability ~~complies~~ comply with ~~the UK MCA LY2 Code for multi hulls and sailing vessels (as amended). Damage stability is to be in compliance with the SOLAS requirements for passenger vessels (as amended). Alternative requirements may be acceptable, subject to acceptance by LR.~~ enhanced stability requirements such as a recognised International Standard.

Section 3
Character of classification and class notations

3.5 Service area and restriction notations

(*Part only shown*)
3.5.5 The service area restriction notations defined below describe the service area restriction for which the craft has been approved and constructed.

G2A	**Service Group 2A** covers craft intended for service in reasonable weather in waters where the range to refuge is 60 nautical miles or less. The geographical limits of the intended service are to be reported to LR. Craft in this group are eligible for assignment of the service type notation **SRY**.

3.6 Service type notations

(*Part only shown*)
3.6.2 A list of service type notations for which craft may be eligible is given below:

Yacht or Support Yacht Craft	This notation will be assigned to all yachts.

3.8 Other hull notations

3.8.1 **Ice class notation**. A class notation for navigation in ~~first year~~ first-year ice conditions will be specially considered.

3.8.5 **SRY**. This notation will be assigned to Short-Range Yachts with service area restriction G2A and in accordance with the MCA *Large Commercial Yacht Code*, MSN 1792(M) requirements for Short-Range Yachts.

Volume 3, Part 3, Chapter 2

Craft Design

Effective date 1 July, 2012

■ *Section 6* Machinery space arrangements

6.6 Double and single bottom structure

6.6.4 For multi-hull craft and other craft which are to be assigned an **HSC** notation or which are to operate within **Restricted Service Groups G1, G2, G2A** and **G3**, the extent of the double bottom will be specially considered depending on the number of transverse watertight bulkheads and the requirements of the National Authority concerning stability after damage.

■ *Section 8* Particular requirements for multi-hulls

8.5 Bulkheads

8.5.1 Longitudinal watertight bulkheads are to be arranged within the bridging structures of multi-hull craft to prevent cross flooding and the spread of smoke and flames in the event of fire. The number and distribution of bulkheads will be specially considered dependent upon the structural configuration and size of the craft but in no case is the number to be less than ~~two for catamarans and four for trimarans. These bulkheads are in general to be positioned in way of the inboard sides of the hulls.~~ :

- one for catamarans of Rule length, L_R, less than or equal to 24 m;
- two for catamarans of Rule length, L_R, greater than 24 m; and
- four for trimarans.

■ *Section 9* Navigation in ice

9.1 General

9.1.1 Where an ice class notation is to be included in the class of a craft, the scantlings will require to be specially considered. The additional requirements for operation in ice will, in general, be in accordance with LR's *Rules and Regulations for the Classification of Ships* (hereinafter referred to as the Rules for Ships), Part 8, where appropriate, and also Pt 6, Ch 5,7, Pt 7, Ch 5,7 and Pt 8, Ch 5,6 for steel, aluminium and composite construction respectively.

9.1.2 It is the responsibility of the Owner to determine which ice class notation is most suitable for their requirements.

9.1.3 The strengthening requirements detailed in this Section are applicable to craft, other than those assigned the notation **HSC** and/or **LDC** (*see* Pt 1, Ch 2), intended for operation in first-year ice conditions.

9.1.4 For a multi-hull craft, special consideration is to be given to the interaction of the ice between the hulls.

9.1.5 The requirements of this Section assume that, when approaching ice-infested waters, the craft's speed will be reduced appropriately. The vertical extent of ice strengthening for craft intended to operate in ice conditions at speeds exceeding 15 knots will be specially considered.

9.2 Ice belt

9.2.1 Side scuttles are not to be situated in the ice belt.

9.2.2 If the weather deck in any part of the craft is situated below the upper limit of the ice belt, the bulwark is to be reinforced to the same degree as the shell plating in the main ice belt.

9.3 Stern construction

9.3.1 A transom stern is not normally to extend below the ice load waterline. Where this cannot be avoided, the transom is to be kept as narrow as possible and the scantlings of plating and stiffeners are to be as required for the midcraft region.

9.4 Bossings and shaft struts

9.4.1 For craft with two or more propellers, shafting and sterntubes are generally to be enclosed within plated bossings. If detached supporting struts are necessary, their design, strengthening and attachment to the hull will be specially considered.

9.5 Powering of ice strengthened craft

9.5.1 For water jets, special consideration is to be given to the potential intake of ice pieces into the impeller causing additional loads and strengthening of steering buckets.

Volume 3, Part 3, Chapter 3

Control Systems

Effective date 1 July, 2012

■ *Section 1*

General

1.3 Navigation in ice

1.3.1 Where an ice class notation is to be included in the class of a craft, the scantlings will require special consideration, *see* Ch 2,9. ~~as determined from this Chapter will require to be specially considered. The additional requirements for operation in ice will, in general, be in accordance with Lloyd's Register's (hereinafter referred to as 'LR') *Rules and Regulations for the Classification of Ships* (hereinafter referred to as the Rules for Ships), Pt 3, Ch 9, where appropriate, and also Ch 5,6 of Parts 6, 7 and 8, for steel, aluminium and composite construction respectively.~~

■ *Section 2*

Rudders

2.17 Bearings

~~*2.17.2* Synthetic rudder stock bearing materials are to be of a type approved by LR.~~

2.17.2 Where it is proposed to use stainless steel for liners or bearings for rudder stocks and/or pintles, the chemical composition is to be submitted for approval. Where the two surfaces are stainless steel materials, they should have suitable resistance to galling. When stainless steel material is used, arrangements to ensure an adequate supply of sea-water to the bearing are to be provided to protect against stagnant sea-water initiated corrosion.

~~*2.17.3* Where it is proposed to use stainless steel bearings for rudder stocks, the chemical composition is to be submitted for approval.~~

2.17.3 Synthetic rudder bearing materials are to be of a type approved by LR.

~~*2.17.4* When stainless steel bearings are used, arrangements to ensure an adequate supply of sea water to the bearing are to be provided.~~

~~*2.17.5* When the rudder stock or liner is grade 316L austenitic stainless steel, it is recommended that gunmetal, lignum vitae or a synthetic bearing material be used in the bush. If a stainless steel is used in the bush, it is to be of a different grade and with an adequate hardness difference. The use of a ferritic/austenitic duplex structure stainless steel is recommended for the bush but 17 per cent to 30 per cent chromium stainless steels are also suitable.~~

2.18 Liners

2.18.2 Where it is proposed to use stainless steel liners, the ~~chemical composition is to be submitted for approval~~ requirements in 2.17.2 are to be complied with.

2.19 Pintles

2.19.8 Where it is proposed to use stainless steel liners, the requirements in 2.17.2 are to be complied with.

Volume 3, Part 3, Chapter 4

Closing Arrangements and Outfit

Effective date 1 July, 2012

■ *Section 7*

Portlights, windows and viewing ports, skylights and glass walls

7.5 Windows

7.5.3 A hydrostatic test is to be carried out in order to examine watertightness. A design pressure p, where p is given in 7.8.1 is to be applied to the external face of the window and maintained for at least 15 minutes.

7.5.4 A hydrostatic test is to be carried out in order to examine the capability of the frame, and glass retaining arrangements. A design pressure $4p$, where p is given in 7.8.1 is to be applied to the external face of the window. Alternatively this test may be carried out using a steel plate in place of the glass. Ideally the steel plate ~~thickness~~ should be of a suitable reduced thickness to simulate the flexural performance of the glass.

7.9 Laminated glass thickness

7.9.1 Laminated toughened safety glass may be used having a thickness greater than the single plate toughened safety glass for the same size window, as given by:

$$t_s^2 = t_{i1}^2 + t_{i2}^2 + ... + t_{in}^2 \quad \text{mm}$$

where

n = number of laminates
t_i = thickness of laminate, in mm
t_s = thickness of equivalent single plate, in mm.

Alternative arrangements that do not meet the above thickness requirement will be specially considered, provided that equivalent strength and bending stiffness to that of a single, thermally toughened pane of thickness, t_s, can be demonstrated in a four-point bending test in accordance with EN-ISO 1288-3 or an equivalent recognised National or International Standard, using no fewer than ten samples. The lower limit of the 90 per cent confidence level interval for the laminated pane shall not be less than the same for monolithic toughened safety glass. Small scale punch test or ring-in-ring test methods shall not be used.

7.12 Deadlights and storm covers

7.12.5 For craft in **Service ~~Group G3,~~ Groups G2A and G3**, storm covers or deadlights are required for:

(a) All windows and portlights in the front of the superstructure or deckhouse on the weather deck.
(b) All windows and portlights in the sides of the superstructure or deckhouse on the weather deck, except where they are interchangeable port and starboard, in which case a sufficient number to fit any one side are to be provided.
(c) Each different size of window and portlight.

7.16 Bonded windows and side scuttles

7.16.1 A ‘bonded window or bonded side scuttle’ is one in which the glazing material is secured in its frame from the outside of the ship by glue or other adhesive material. No mechanical fixing is provided for the glazing. Bonded windows and bonded side scuttles are to comply with the requirements of 7.5 and 7.4 respectively, in addition to the requirements in this Section. Proposals to secure glazing from the inside of the ship are to be specially considered using the requirements in this Section as a basis. It should be noted that bonding from the inside is not recommended and where it is proposed, further testing will be required. Non-load-bearing secondary bonded glazing, e.g., glazing to improve thermal insulation, is not required to comply with the requirements of this sub-Section.

7.16.2 The adhesive is to be flexible enough to support the glazing without holding it firm. The glue strip is to be elastic, with width and thickness designed to allow the glazing to move in both directions in the plane of the glazing without undue forces on the bonding or the substrate. The glass is to be free to settle under load and not be forced to follow deflections in the supporting structure. If substantial racking of the glazing opening under load is expected, the bonding is to be designed to accommodate such deflections.

7.16.3 Bonded windows and side scuttles may be considered as acceptable, in general, on yachts, depending on their position, size of yacht and applicable statutory requirements, noting the distinction between glazing and the frame, which may have different requirements.

7.16.4 Bonded windows and side scuttles are not permitted in galley areas, including glazing in galley doors (internal or external). They are not permitted on escape routes and evacuation routes where a fire rating is required. The fire integrity of bulkheads is not to be impaired.

7.16.5 The failure of laminated glass is considered to pose a lower risk to safety than that of single pane glass. In the event of breaking, laminated glass more readily holds together and tends not to break up into large sharp pieces. Therefore, in general, laminated glazing is preferred. When laminated glass is used, the sealant is to be compatible with the interlayer. Lamination thickness is to be in accordance with 7.9.1. Special consideration will be given to single pane toughened safety glass.

7.16.6 The durability of the adhesive and the sealant in the long-term marine environment is to be considered in the approval process. Adhesive is to be approved in accordance with Vol 2, Pt 2, Ch 14,2.15. The adhesive bead is to be resistant to or protected from UV radiation, either by an optically dense area at the edges of the glazing or by overlapping trim or UV shielding tape. The adhesive bead is to be resistant to or protected from fungal attack. Arrangements are to be in accordance with the adhesive manufacturer’s published guidelines and relevant LR Rules.

7.16.7 The edges of the bonding recess are to be rounded to facilitate the application of the sealant without air entrapment. The width of the gap between the flange and the glazing is to be large enough to accommodate the movement of the glazing as a result of hull deflection and thermal expansion, *see* Fig. 4.7.2. Recommended gap widths for bonded windows are to be taken as:

Gap width	Length of longest side of window
10–15 mm	< 1,5 m
15–20 mm	1,5–3,0 m

7.16.8 The minimum adhesive width and thickness are to be in accordance with the adhesive manufacturer’s published guidelines.

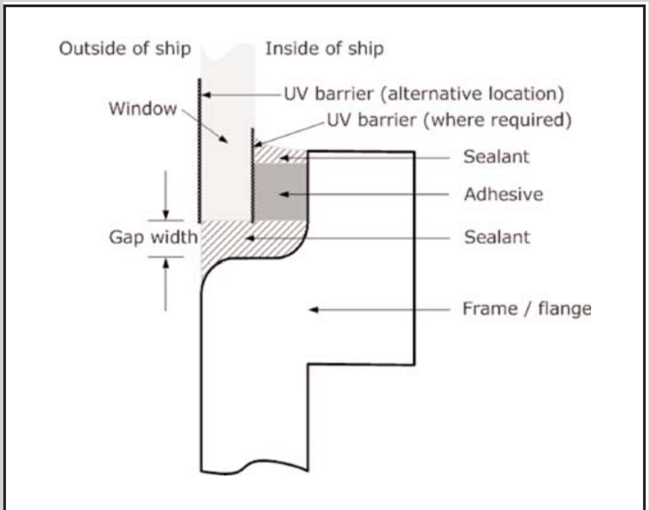


Fig. 4.7.2
Gap width between flange and window, bonded from the outside of the ship

■ *Section 11* Ventilators

11.4 Closing appliances

11.4.2 In order to limit the fire growth potential in every space of the ship, the main inlets and outlets of all ventilation systems shall be capable of being closed from outside the spaces being ventilated. The means of closing shall be easily accessible as well as be prominently and permanently marked and shall indicate whether the inlet or outlet is open or closed. Battery room ventilators are to be fitted with a means of closing only when:

(a) the battery room does not open directly onto an exposed deck; or
(b) the ventilation opening for the battery room is required to be fitted with a closing device according to the Load Line Convention; or
(c) the battery room is fitted with a fixed gas fire-extinguishing system.

Existing paragraphs 11.4.2 *to* 11.4.7 *have been renumbered* 11.4.3 *to* 11.4.8.

Volume 3, Part 3, Chapter 5

Anchoring and Mooring Equipment

Effective date 1 July, 2012

■ *Section 3* Service group factors

3.3 G2, G3, G2A and G4 craft

3.3.1 For craft in **Service Groups G2**, **G2A, G3**, and **G4**, the mass of the anchor required by Table 5.5.1 may be multiplied by the following factors:

Service Group G2	0,60
Service Group G2A	0,65
Service Group G3	0,73
Service Group G4	1,00

■ *Section 6* Anchor cable

6.4 Wire rope

(*Part only shown*)
6.4.1 When the Equipment Number does not exceed 500 for craft in **Service Groups G1**, **G2, G2A** and **G3**, steel wire rope may be accepted in lieu of chain cable under the following conditions:

Volume 3, Part 4, Chapter 2

All Yachts

Effective date 1 July, 2012

Section 8

Navigation in first-year ice conditions

8.1 General

~~*8.1.1* Where additional strengthening is fitted in accordance with the requirements of Pt 6, Ch 5,7, Pt 7, Ch 5,7 and Pt 8, Ch 5,6 an appropriate special features notation will be assigned. It is the responsibility of the Owner to determine which notation is most suitable for their requirements.~~

~~*8.1.2* When yachts may be expected to visit areas requiring them to navigate in light first year ice conditions other than the Northern Baltic corresponding to unbroken level ice of thickness not greater than 0,4 m, the hull is to meet the requirements necessary for the assignment of **Ice Class 1D**~~.

8.1.1 Where an ice class notation is to be included in the class of a craft, the scantlings will require special consideration, *see* Pt 3, Ch 2,9.

~~*8.1.3*~~ *8.1.2* Yachts in Service Group G6, which have their own propulsion machinery, and which are built of steel but are not strengthened for navigation in ice, may be eligible for assignment of Finnish-Swedish Ice-Due Class II under the Finnish and Swedish Boards of Navigation *Finnish-Swedish Ice Class Rules*. Yachts in Service Groups G1–G4 inclusive, constructed in any material, together with Yachts in Service Group G6 constructed in aluminium or composites are not eligible for this notation.

~~*8.1.4* For Yachts requiring to navigate in areas of ice in excess of that specified in 10.1.2, the standard of construction is to comply with the requirements of Part 8 of the *Rules and Regulations for the Classification of Ships* as appropriate.~~

Section 9

Support yacht craft

9.1 General

9.1.1 A **support yacht craft** provides support to a ‘primary’ yacht and may often also be referred to as a ‘shadow yacht’. The support yacht may provided with an extensive range of equipment and facilities to perform these duties, such as small craft, seaplanes, large galleys and waste management systems.

9.1.2 For support yachts, the following are also to be considered according to the load line requirements:

(a) Sill heights of door openings;
(b) Windows and portlights;
(c) Freeing port areas; and
(d) Sill heights of ventilators.

Volume 3, Part 4, Chapter 3

Special Considerations for Sailing Yachts

Effective date 1 July, 2012

■ *Section 1*
Hull design and construction parameters

1.2 Mast and rigging support arrangements

1.2.1 Sailing yacht mast and standing rigging loadings and their support structure require special consideration as follows:

(a) Adequate hull and deck longitudinal structure to resist hull bending.
(b) Provision of adequate transverse structure in way of masts, chainplates, keels, skegs, etc.
(c) Provision of adequate bottom structure to support the mast and dissipate the mast loadings.
(d) Local reinforcement as given in Pt 8, Ch 3,3.14 in way of chainplates, forestay and backstay fittings, etc.
(e) The deck and beams are to be suitably strengthened in way of masts, coachroof/deckhouse ends, windlass, cleats, sheet winches, sheet tracks, etc. Where a mast is stepped on the deck or coachroof/deckhouse the structural arrangements will be specially considered.

■ *Section 5*
Deck fittings

5.1 General

5.1.3 Details of inserts, local reinforcement and through bolting arrangements for yachts of composite construction are to be in accordance with Pt 8, Ch 2 and Ch 3.

Volume 3, Part 5, Chapter 2

Local Design Loads

Effective date 1 July, 2012

■ *Section 2*
Definitions and symbols

2.3 Minimum significant wave height

Table 2.2.1 Minimum significant wave height, $H_{1/3}$

Service Group	Minimum significant wave height, in metres
1	0,6
2	1,0
2A	1,5
3	2,0
4	4,0
5	4,0
6	4,0

Volume 3, Part 5, Chapter 3

Local Design Criteria for Craft Operating in Non-Displacement Mode

Effective date 1 July, 2012

■ *Section 2*
Nomenclature and design factors

2.2 Design factors

Table 3.2.2 Service group factor, G_f

Service area restriction notation	Factor
G1	0,6
G2	0,75
G2A	0,8
G3	0,85
G4	1,0
G5	1,2
G6	1,25

Volume 3, Part 5, Chapter 4

Local Design Criteria for Craft Operating in Displacement Mode

Effective date 1 July, 2012

■ *Section 2*
Nomenclature and design factors

2.2 Design factors

Table 4.2.1 Service group factor, G_f

Service area restriction notation	Factor
G1	0,6
G2	0,75
G2A	0,8
G3	0,85
G4	1,0
G5	1,2
G6	1,25

Volume 3, Part 5, Chapter 5

Global Load and Design Criteria

Effective date 1 July, 2012

Section 2

Hull girder load criteria for mono-hull craft

2.2 Vertical wave bending moments

(*Part only shown*)

2.2.1 For all craft except patrol craft in Service Group G6, the minimum value of vertical wave bending moment, M_w at any position along the craft may be taken as follows:

G_f = service group factor, *see* Pt 1, Ch 2,3.5.5
= 0,5 for G1 craft
= 0,6 for G2 craft
= 0,65 for G2A craft
= 0,7 for G3 craft
= 0,8 for G4 craft
= 1,0 for G5 and G6 craft (yachts only)

Section 3

Hull girder load criteria for multi-hull craft

3.2 Vertical wave bending moments and associated shear forces

(*Part only shown*)

3.2.1 The vertical wave bending moments, M_{MW}, including wave and still water effects, at amidship is given by the following:

G_f = service group factor, *see* Pt 1, Ch 2,3.5.5
= 0,5 for G1 craft
= 0,6 for G2 craft
= 0,65 for G2A craft
= 0,7 for G3 craft
= 0,8 for G4 craft
= 1,0 for G5 and G6 craft

Section 4

Primary load criteria for multi-hull craft

4.2 Global loads for multi-hull craft with partially submerged hulls

(*Part only shown*)

4.2.1 The twin hull transverse bending moment, M_B, about a longitudinal axis is given by:

G_f = service group factor, *see* Pt 1, Ch 2,3.5.5
= 1,25 for G1 and G2
= 1,35 for G2A
= 1,50 for G3
= 2,00 for G4
= 2,50 for G5 and G6

(*Part only shown*)

4.2.2 The twin hull torsional connecting moment, M_T, is given by:

G_f = service group factor, *see* Pt 1, Ch 2,3.5.5
= 0,63 for G1 and G2
= 0,70 for G2A
= 0,75 for G3
= 1,00 for G4
= 1,25 for G5 and G6

(*Part only shown*)

4.2.3 The vertical shear force, Q_T, at the centreline of the cross-deck structure between the twin hulls is given by:

G_f = service group factor, *see* Pt 1, Ch 2,3.5.5
= 1,25 for G1 and G2
= 1,35 for G2A
= 1,50 for G3
= 2,00 for G4
= 2,50 for G5 and G6

4.3 Global loads for multi-hull craft with fully submerged hulls

(*Part only shown*)

4.3.1 The design side force acting at mid-draught of the hull is given by:

G_f = service group factor, *see* Pt 1, Ch 2,3.5.5
= 8,5 for G1 and G2
= 9,4 for G2A
= 10,2 for G3
= 13,6 for G4
= 17,0 for G5 and G6

(*Part only shown*)

4.3.4 The twin hull torsional connecting moment, M_T, is given by:

G_f = service group factor, *see* Pt 1, Ch 2,3.5.5
= 0,63 for G1 and G2
= 0,70 for G2A
= 0,75 for G3
= 1,00 for G4
= 1,25 for G5 and G6

(*Part only shown*)

4.3.5 The vertical shear force, Q_T, at the centreline of the cross-deck structure between the twin hulls is given by:

G_f = service group factor, *see* Pt 1, Ch 2,3.5.5
= 1,25 for G1 and G2
= 1,35 for G2A
= 1,50 for G3
= 2,00 for G4
= 2,50 for G5 and G6

Volume 4, Part 6, Chapter 4

Scantling Determination for Multi-Hull Craft

Effective date 1 July, 2012

■ *Section 7*

Bulkheads and deep tanks

7.2 Longitudinal bulkheads within the cross-deck structure

7.2.1 Longitudinal bulkheads are to be fitted within the cross-deck structure to prevent cross flooding and the spread of flame and smoke. The minimum number of such bulkheads is to be ~~two for catamarans and four for trimarans.~~:

- one for catamarans of Rule length, L_R, less than or equal to 24 m;
- two for catamarans of Rule length, L_R, greater than 24 m; and
- four for trimarans.

Quadrimarans and other craft of novel configuration will be specially considered.

Volume 4, Part 6, Chapter 5

Special Features

Effective date 1 July, 2012

■ *Section 3*

Vehicle decks

3.3 Deck plating

Table 5.3.1 Deck plate thickness calculation (*Part only shown*)

Symbols	Expression	
a, s, u, and v as defined in Fig. 5.3.1 n = tyre correction factor as detailed in Table 5.3.2 P_1 = corrected patch load, in tonnes λ = dynamic magnification factor P_w = load, in tonnes, on the tyre print. For closely spaced wheels the shaded area shown in Fig. 5.3.1 may be taken as the combined print f_1 ϕ_1 = patch aspect ratio correction factor f_2 ϕ_1 = panel aspect ratio correction factor f_3 ϕ_1 = wide patch load factor	$P_1 = \phi_1\,\phi_2\,\phi_3\,\lambda\,P_w$	
	$\phi_1 = \dfrac{2v_1 + 1{,}1s}{u_1 + 1{,}1s}$	$v_1 = v$, but $\leq s$ $u_1 = u$, but $\leq a$
	$\phi_2 = 1{,}0$	for $u \leq (a - s)$
	$= \dfrac{1}{1{,}3 - \dfrac{0{,}3}{s}(a - u)}$	for $a \geq u > (a - s)$
	$= \cancel{\dfrac{2v_1 + 1{,}1s}{u_1 + 1{,}1s}}\ 0{,}77\ \dfrac{a}{u}$	for $u > a$

Section 6
Helicopter landing areas

6.3 Landing area plating

(*Part only shown*)

6.3.1 The deck plate thickness, t_p, within the landing area is to be not less than:

P_w = landing load~~,~~ on the tyre print in tonnes:

For helicopters with a single main rotor, P_w is to be taken as P_h divided equally between the two main undercarriage~~s (for helicopters with single main rotor~~ wheels.

For helicopters with tandem main rotors, P_w is to be taken as P_h distributed between all main undercarriage wheels in proportion to the static loads they carry.

For helicopters fitted with landing gear consisting of skids, P_w is to be taken as P_h distributed in accordance with the actual load distribution given by the airframe manufacturer. If this is unknown, P_w is to be taken as $1/6P_h$ for each of the two forward contact points and $1/3P_h$ for each of the two aft contact points. The load may be assumed to act as a 300 mm x 10 mm line load at each end of each skid when applying Fig. 5.3.1.

γ = a location factor given in Table 5.6.1

~~k_s is as defined in 1.2~~.

~~The~~ For wheeled undercarriages, the tyre print dimensions specified by the manufacturer are to be used for the calculation. Where these are unknown, it may be assumed that the print area is 300 x 300 mm and this assumption is to be indicated on the submitted plan.

For skids and tyres with an asymmetric print, the print is to be considered oriented both parallel and perpendicular to the longest edge of the plate panel and the greatest corresponding value of α taken from Fig. 5.3.1.

~~*6.3.2* For helicopters fitted with landing gear consisting of skids, the print dimensions specified by the manufacturer are to be used. Where these are unknown, it may be assumed that the print consists of a 300 mm line load at each end of each skid, when applying Fig. 5.3.1.~~

6.4 Deck stiffening and supporting structure

6.4.1 The helicopter deck stiffening and the supporting structure are ~~is~~ to be designed for the load cases given in Table 5.6.2, with the helicopter being positioned so as to produce the most severe loading condition for each structural member under consideration.

Section 7
Strengthening requirements for navigation in ice conditions

7.1 General

7.1.1 Where an ice class notation is to be included in the class of a craft, the scantlings will require special consideration, *see* Pt 3, Ch 2,9.

~~*7.1.1* The strengthening requirements detailed in this Section are applicable to craft, other than those assigned the notation **HSC** and/or **LDC** (see Pt 1, Ch 2), intended for operation in light first-year ice conditions in areas other than the northern Baltic corresponding to unbroken level ice of thickness not greater than 0,4 m.~~

~~*7.1.2* Craft complying with the requirements of this Section, in addition to the requirements for sea-going service where applicable, will be eligible for the special features notation **Ice Class 1D**. Alternatively, a Special Duties Notation may be assigned indicating that the craft has been additionally strengthened for duties in ice, see Pt 1, Ch 2,3.8.~~

~~*7.1.3* Craft designed to operate in ice conditions other than those detailed in 7.1.1 are to comply with Part 8 of the *Rules and Regulations for the Classification of Ships*.~~

~~*7.1.4* The requirements of this Section are applicable to both longitudinally and transversely framed craft and concern the shell plating and framing in the forward region, the stem, sternframe, rudder and the steering gear.~~

Table 5.6.2 Design load cases for deck stiffening and supporting structure

Loadcase	Loads			
	Landing area		Supporting structure, *see* Note 1	
	UDL, in kN/m^2	Helicopter patch load *see* Note 2	Self-weight	Horizontal load *see* Note 2
(1) Overall distributed loading	2	–	–	–
(2) Helicopter emergency landing	~~0,2~~ 0,5	~~$2{,}5P_h f$~~ $2{,}5P_w f$	W_h	$0{,}5P_h$
(3) Normal usage	0,5	~~$1{,}5P_h$~~ $1{,}5P_w$	W_h	$0{,}5P_h + 0{,}5W_h$

Symbols

P_h, P_w and f are as defined in ~~5.4.1~~ 6.3.1

UDL = uniformly distributed vertical load over entire landing area~~, kN/m^2~~

W_h = structural self-weight of helicopter platform, in tonnes

NOTES
1. For the design of the supporting structure for helicopter platforms applicable self-weight and horizontal loads are to be added to the landing area loads.
2. The helicopter is to be so positioned as to produce the most severe loading condition for each structural member under consideration.

~~*7.1.5* The vertical extent of the ice strengthening is related to the ice light and load waterlines, which are defined in 7.2. The maximum and minimum Ice Class draughts at both the fore and aft ends will be stated on the Class Certificate.~~

~~*7.1.6* The requirements of this Section assume that when approaching ice infested waters the craft's speed will be reduced appropriately. The vertical extent of ice strengthening for craft intended to operate in ice conditions at speeds exceeding 15 knots will be specially considered.~~

~~*7.1.7* The ballast capacity of propeller driven craft is to be sufficient to give adequate propeller immersion in all ice navigating conditions without trimming the craft in such a manner that the actual waterline at the bow is below the ice light waterline. Ballast tanks situated above the ice light waterline and adjacent to the shell, which are intended to be used in ice navigating conditions, are to be provided with heating pipes.~~

~~7.2 Definitions~~

~~*7.2.1* The Ice Load Waterline is that corresponding to the Fresh Water Summer Loadline.~~

~~*7.2.2* The Ice Light Waterline is that corresponding to the lightest condition in which the craft is expected to navigate in ice.~~

~~*7.2.3* The Ice Load Waterline and the Ice Light Waterline are to be indicated on the plans. For navigation in certain geographical areas, the relevant National Authority may require the maximum Ice Class draught to be marked on the craft in a specified manner.~~

~~*7.2.4* The Main Ice Belt Zone extends vertically from 500 mm below the Ice Light Waterline to 400 mm above the Ice Load waterline and horizontally from the stem to 0,02LR m aft of the point at which the deepest load waterline reaches its greatest breadth.~~

~~7.3 Powering of ice strengthened craft~~

~~*7.3.1* Ice strengthened craft are assumed to be capable of developing sufficient thrust to permit continuous mode icebreaking at a speed of at least five knots in ice having a thickness of 0,4 m and a snow cover of at least 0,3 m.~~

~~7.4~~ 7.2 Shell plating

~~*7.4.1* In way of the main ice belt zone, the thickness of the shell plating is to be determined by direct calculation. A copy of these calculations is to be submitted for consideration.~~

~~*7.4.2*~~ *7.2.1* Changes in plating thicknesses in the longitudinal direction are to take place gradually.

~~*7.4.3* Side scuttles are not to be situated in the ice belt.~~

~~*7.4.4* If the weather deck in any part of the craft is situated below the upper limit of the ice belt, the bulwark is to be reinforced to the same degree as the shell plating in the main ice belt.~~

~~*7.4.5*~~ *7.2.2* In general all welded seams and butts in way of the main ice belt are to be dressed smooth.

~~7.5 Shell framing requirements~~

~~*7.5.1* Ice framing is to extend a minimum distance of 1000 mm above the Ice Load Waterline and 1600 mm below the Ice Light Waterline between the stem and 0,02LR m aft of the point at which the deepest load waterline reaches its greatest breadth.~~

~~*7.5.2* The web thickness of ice framing is not, in general, to be less than half that of the attached shell plating.~~

~~*7.5.3* Ice frames are to be attached to the shell plating by double continuous welding and are not to be scalloped except at shell plating seams or butts. Air and drain holes are to be kept to a minimum.~~

~~*7.5.4* Main and intermediate frames within the minimum extent of ice framing are to be efficiently supported to prevent tripping. The distance between anti-tripping supports is not to exceed 1000 mm.~~

~~*7.5.5* The section modulus of an ice framing stiffening member is to be determined by direct calculation. A copy of these calculations is to be submitted for consideration.~~

~~*7.5.6* Where transverse framing is adopted, ice stringers (primary longitudinal members supporting ice framing) are to be spaced not more than 1000 mm apart and are to have a section modulus not less than four times the section modulus of the transverse framing.~~

~~*7.5.7* Where longitudinal framing is adopted, ice stringers need not be fitted.~~

~~7.6 Stem construction~~

~~*7.6.1* Where a plate stem is fitted, the plate thickness is to be not less than 1,3 times that determined by Ch 3,3.3.~~

~~*7.6.2* Where a bar stem is fitted, its cross-sectional area is to be not less than 1,25 times that determined by Ch 3,5.12.~~

~~7.7 Stern construction~~

~~*7.7.1* A transom stern is not normally to extend below the ice load waterline. Where this cannot be avoided, the transom is to be kept as narrow as possible and the scantlings of plating and stiffeners are to be as required for the midcraft region.~~

~~7.8 Bossings and shaft struts~~

~~*7.8.1* For craft with two or more propellers, shafting and sterntubes are generally to be enclosed within plated bossings. If detached supporting struts are necessary, their design, strengthening and attachment to the hull will be specially considered.~~

~~7.9 Rudder and steering arrangements~~

~~*7.9.1* Rudder posts, rudder horns, sole pieces, rudder stocks and pintles are to be dimensioned in accordance with Pt 3, Ch 3,2. The speed used in the calculations is to be the service speed or 14 knots, whichever is the greater.~~

~~*7.9.2* The thickness of rudder plating and webs is to be increased by 10 per cent over the requirements of Pt 3, Ch 3,2.~~

~~*7.9.3* Due regard is to be paid to the method of securing the rudder in the centreline position when backing into ice. Where possible, rudder stoppers working on the blade or rudder head are to be fitted.~~

~~*7.9.4* Where steering nozzles are fitted, the thickness of the shroud plating is to include an abrasion allowance of 2 mm.~~

~~*7.9.5* The scantlings of the stock, pintles, gudgeon and sole pieces associated with the nozzle are to be increased on the basis given in 7.9.1. However, the diameter of the nozzle stock is to be not less than that calculated in the astern condition taking the astern speed as seven knots or the actual astern speed, whichever is the greater.~~

~~*7.9.6* Nozzles with articulated flaps will be subject to special consideration.~~

Volume 5, Part 7, Chapter 2

Construction Procedures

Effective date 1 July, 2012

■ *Section 2*
Materials

2.4 Mechanical properties for design

2.4.1 The minimum tensile strength properties of aluminium alloys approved for structural use are given in ~~Table 2.2.1~~ Ch 13,8.3.2 of the Rules for Materials. Other alloys and conditions of temper may be accepted in accordance with 2.1.3.

Table 2.2.1 *has been deleted*.

Volume 5, Part 7, Chapter 4

Scantling Determination for Multi-Hull Craft

Effective date 1 July, 2012

■ *Section 7*
Bulkheads and deep tanks

7.2 Longitudinal bulkheads within the cross-deck structure

7.2.1 Longitudinal bulkheads are to be fitted within the cross-deck structure to prevent cross flooding and the spread of flame and smoke. The minimum number of such bulkheads is to be ~~two for catamarans and four for trimarans.~~:

- one for catamarans of Rule length, L_R, less than or equal to 24 m;
- two for catamarans of Rule length, L_R, greater than 24 m; and
- four for trimarans.

Quadrimarans and other craft of novel configuration will be specially considered.

Volume 5, Part 7, Chapter 5

Special Features

Effective date 1 July, 2012

■ *Section 6* Helicopter landing areas

6.3 Landing area plating

(*Part only shown*)
6.3.1 The deck plate thickness, t_p, within the landing area is to be not less than:

P_w = landing load~~,~~ on the tyre print in tonnes:
For helicopters with a single main rotor, P_w is to be taken as P_h divided equally between the two main undercarriage~~s (for helicopters with single main rotor~~ wheels.
For helicopters with tandem main rotors, P_w is to be taken as P_h distributed between all main undercarriage wheels in proportion to the static loads they carry.
For helicopters fitted with landing gear consisting of skids, P_w is to be taken as P_h distributed in accordance with the actual load distribution given by the airframe manufacturer. If this is unknown, P_w is to be taken as $1/6P_h$ for each of the two forward contact points and $1/3P_h$ for each of the two aft contact points. The load may be assumed to act as a 300 mm x 10 mm line load at each end of each skid when applying Fig. 5.3.1.
γ = a location factor given in Table 5.6.1.
~~k_s - is as defined in 1.2~~.

~~The~~ For wheeled undercarriages, the tyre print dimensions specified by the manufacturer are to be used for the calculation. Where these are unknown, it may be assumed that the print area is 300 x 300 mm and this assumption is to be indicated on the submitted plan.
For skids and tyres with an asymmetric print, the print is to be considered oriented both parallel and perpendicular to the longest edge of the plate panel and the greatest corresponding value of α taken from Fig. 5.3.1.

~~*6.3.2* For helicopters fitted with landing gear consisting of skids, the print dimensions specified by the manufacturer are to be used. Where these are unknown, it may be assumed that the print consists of a 300 mm line load at each end of each skid, when applying Fig. 5.3.1.~~

6.4 Deck stiffening and supporting structure

6.4.1 The helicopter deck stiffening and the supporting structure are ~~is~~ to be designed for the load cases given in Table 5.6.2, with the helicopter being positioned so as to produce the most severe loading condition for each structural member under consideration.

Table 5.6.2 Design load cases for deck stiffening and supporting structure

Loadcase	Loads (tonnes)			
	Landing area		Supporting structure, *see* Note 1	
	UDL, in kN/m^2	Helicopter patch load *see* Note 2	Self-weight	Horizontal load *see* Note 2
(1) Overall distributed loading	2	–	–	–
(2) Helicopter emergency landing	~~0,2~~ 0,5	~~$2{,}5P_h f$~~ $2{,}5P_w f$	W_h	$0{,}5P_h$
(3) Normal usage	0,5	~~$1{,}5P_h$~~ $1{,}5P_w$	W_h	$0{,}5P_h + 0{,}5W_h$

Symbols

P_h, P_w and f are as defined in 5.4.1 6.3.1.
UDL = Uniformly distributed vertical load over entire landing area~~, kN/m^2~~
W_h = structural self-weight of helicopter platform, in tonnes

NOTES
1. For the design of the supporting structure for helicopter platforms applicable self-weight and horizontal loads are to be added to the landing area loads.
2. The helicopter is to be so positioned as to produce the most severe loading condition for each structural member under consideration.

■ *Section 7*
Strengthening requirements for navigation in ice conditions

7.1 General

7.1.1 Where an ice class notation is to be included in the class of a craft, the scantlings will require special consideration, *see* Pt 3, Ch 2,9.

~~*7.1.1* The strengthening requirements detailed in this Section are applicable to craft, other than those assigned the notation **HSC** and/or **LDC** (*see* Pt 1, Ch 2), intended for operation in light first-year ice conditions in areas other than the northern Baltic corresponding to unbroken level ice of thickness not greater than 0,4 m.~~

~~*7.1.2* Craft complying with the requirements of this Section, in addition to the requirements for sea-going service where applicable, will be eligible for the special features notation **Ice Class 1D**. Alternatively, a Special Duties Notation may be assigned indicating that the craft has been additionally strengthened for duties in ice, *see* Pt 1, Ch 2,3.8.~~

~~*7.1.3* Craft designed to operate in ice conditions other than those detailed in 7.1.1 are to comply with Part 8 of the *Rules and Regulations for the Classification of Ships*.~~

~~*7.1.4* The requirements of this Section are applicable to both longitudinally and transversely framed craft and concern the shell plating and framing in the forward region, the stem, sternframe, rudder and the steering gear.~~

~~*7.1.5* The vertical extent of the ice strengthening is related to the ice light and load waterlines, which are defined in 7.2. The maximum and minimum Ice Class draughts at both the fore and aft ends will be stated on the Class Certificate.~~

~~*7.1.6* The requirements of this Section assume that when approaching ice infested waters the craft's speed will be reduced appropriately. The vertical extent of ice strengthening for craft intended to operate in ice conditions at speeds exceeding 15 knots will be specially considered.~~

~~*7.1.7* The ballast capacity of propeller driven craft is to be sufficient to give adequate propeller immersion in all ice navigating conditions without trimming the craft in such a manner that the actual waterline at the bow is below the ice light waterline. Ballast tanks situated above the ice light waterline and adjacent to the shell, which are intended to be used in ice navigating conditions, are to be provided with heating pipes.~~

~~7.2 Definitions~~

~~*7.2.1* The Ice Load Waterline is that corresponding to the Fresh Water Summer Loadline.~~

~~*7.2.2* The Ice Light Waterline is that corresponding to the lightest condition in which the craft is expected to navigate in ice.~~

~~*7.2.3* The Ice Load Waterline and the Ice Light Waterline are to be indicated on the plans. For navigation in certain geographical areas, the relevant National Authority may require the maximum Ice Class draught to be marked on the craft in a specified manner.~~

~~*7.2.4* The Main Ice Belt Zone extends vertically from 500 mm below the Ice Light Waterline to 400 mm above the Ice Load waterline and horizontally from the stem to 0,02LR m aft of the point at which the deepest load waterline reaches its greatest breadth.~~

~~7.3 Powering of ice strengthened craft~~

~~*7.3.1* Ice strengthened craft are assumed to be capable of developing sufficient thrust to permit continuous mode icebreaking at a speed of at least five knots in ice having a thickness of 0,4 m and a snow cover of at least 0,3 m.~~

~~7.4~~ 7.2 Shell plating

~~*7.4.1*~~ *7.2.1* In way of the main ice belt zone, the thickness of the shell plating is to be determined by direct calculation. A copy of these calculations ~~are~~ is to be submitted for consideration.

~~*7.4.2*~~ *7.2.2* Changes in plating thicknesses in the longitudinal direction are to take place gradually.

~~*7.4.3* Side scuttles are not to be situated in the ice belt.~~

~~*7.4.4* If the weather deck in any part of the craft is situated below the upper limit of the ice belt, the bulwark is to be reinforced to the same degree as the shell plating in the main ice belt.~~

~~*7.4.5*~~ *7.2.3* In general all welded seams and butts in way of the main ice belt are to be dressed smooth.

~~7.5~~ 7.3 Shell framing requirements

~~*7.5.1* Ice framing is to extend a minimum distance of 1000 mm above the Ice Load Waterline and 1600 mm below the Ice Light Waterline between the stem and 0,02LR m aft of the point at which the deepest load waterline reaches its greatest breadth.~~

~~*7.5.2* The web thickness of ice framing is not, in general, to be less than half that of the attached shell plating.~~

~~*7.5.3* Ice frames are to be attached to the shell plating by double continuous welding and are not to be scalloped except at shell plating seams or butts. Air and drain holes are to be kept to a minimum.~~

~~*7.5.4* Main and intermediate frames within the minimum extent of ice framing are to be efficiently supported to prevent tripping. The distance between anti-tripping supports is not to exceed 1000 mm.~~

~~7.5.5~~ *7.3.1* The section modulus of an ice framing stiffening member is to be determined by direct calculation. A copy of these calculations is to be submitted for consideration.

~~*7.5.6* Where transverse framing is adopted, ice stringers (primary longitudinal members supporting ice framing) are to be spaced not more than 1000 mm apart and are to have a section modulus not less than four times the section modulus of the transverse framing.~~

~~*7.5.7* Where longitudinal framing is adopted, ice stringers need not be fitted.~~

~~7.6 Stem construction~~

~~*7.6.1* Where a plate stem is fitted, the plate thickness is to be not less than 1,3 times that determined by Ch 3,3.3.~~

~~*7.6.2* Where a bar stem is fitted, its cross-sectional area is to be not less than 1,25 times that determined by Ch 3,5.12.~~

~~7.7 Stern construction~~

~~*7.7.1* A transom stern is not normally to extend below the ice load waterline. Where this cannot be avoided, the transom is to be kept as narrow as possible and the scantlings of plating and stiffeners are to be as required for the midcraft region.~~

~~7.8 Bossings and shaft struts~~

~~*7.8.1* For craft with two or more propellers, shafting and sterntubes are generally to be enclosed within plated bossings. If detached supporting struts are necessary, their design, strengthening and attachment to the hull will be specially considered.~~

~~7.9 Rudder and steering arrangements~~

~~*7.9.1* Rudder posts, rudder horns, sole pieces, rudder stocks and pintles are to be dimensioned in accordance with Pt 3, Ch 3,2. The speed used in the calculations is to be the service speed or 14 knots, whichever is the greater.~~

~~*7.9.2* The thickness of rudder plating and webs is to be increased by 10 per cent over the requirements of Pt 3, Ch 3,2.~~

~~*7.9.3* Due regard is to be paid to the method of securing the rudder in the centreline position when backing into ice. Where possible, rudder stoppers working on the blade or rudder head are to be fitted.~~

~~*7.9.4* Where steering nozzles are fitted, the thickness of the shroud plating is to include an abrasion allowance of 2 mm.~~

~~*7.9.5* The scantlings of the stock, pintles, gudgeon and sole pieces associated with the nozzle are to be increased on the basis given in 7.9.1. However, the diameter of the nozzle stock is to be not less than that calculated in the astern condition taking the astern speed as seven knots or the actual astern speed, whichever is the greater.~~

~~*7.9.6* Nozzles with articulated flaps will be subject to special consideration.~~

Volume 6, Part 8, Chapter 2

Construction Procedure

Effective date 1 July, 2012

■ *Section 1*
General requirements

1.4 Builder's facilities

1.4.1 Sections 1.4 and 1.5 are applicable to the facilities and works for the craft under survey.

Existing paragraphs 1.4.1 *to* 1.4.3 *have been renumbered* 1.4.2 *to* 1.4.4.

■ *Section 2*
Materials

2.16 Materials for integrated structural members

2.16.1 Metallic materials, ~~such as steel or aluminium alloys~~ (such as suitable marine grades of stainless steel or aluminium alloys) used in the construction are to comply with the requirements of 2.1.2. Where structural members or components manufactured from these, or other materials, are to be encapsulated within or structurally bonded to laminates, the material is not to adversely affect the cure of the resin system. The surface area of the component that will be in contact with the resin is to be thoroughly cleaned, degreased and, where practicable, either shot blasted or abraded to provide a key.

Section 3
General construction process

3.3 Laminating

3.3.4 The gel coat resin is to be applied by brush, roller or spraying equipment to give a uniform, nominal film thickness ~~of 0,5~~ not exceeding 1,5 mm.

3.9 Laminate detail

~~*3.9.14* Areas of single skin structure in way of the attachment of fittings or equipment are, in general, to be increased in thickness by not less than 50 per cent, with the additional layers staggered beyond the extremities of the surrounding stiffening.~~

~~*3.9.15* The design of the structure in way of the attachment of fittings or equipment in sandwich structures is to be such that the induced loads can be transmitted into the surrounding structure by bending as opposed to shear. The areas are to, in general, take the form of suitably reinforced single skin areas, see 3.9.14, with the additional layers of reinforcement staggered out onto the surrounding inner and outer skins as indicated in Fig. 3.3.1.~~

Existing paragraphs 3.9.16 *to* 3.9.19 *have been renumbered* 3.9.14 *to* 3.9.17.

Section 4
Additional procedures for sandwich construction

~~4.5 Shear ties~~

~~*4.5.1* Shear ties between the inner and outer skins are to be provided at intervals not greater than that required by Ch 3,1.13, and are to be detailed on the plans submitted for approval.~~

~~*4.5.2* Alternative shear tie arrangements will be individually considered.~~

Section 5
Details and fastenings

5.7 Backing bars and tapping plates

5.7.2 Metallic plates and bars are to comply with the requirements of 2.1.2 (such as suitable marine grades of stainless steel or aluminium alloys) ~~be suitably protected against corrosion~~.

5.9 Secondary bonding and peel ply

5.12 Local reinforcement

5.12.1 Areas subject to local loads or increased stress are to be suitably reinforced, details of which are to be indicated on the submitted plans, *see* ~~*also*~~ Ch 3,3.14.

~~*5.12.2* Areas of local reinforcement will be individually considered and direct calculations are to be submitted, see 3.9.14.~~

5.12.2 The design of the structure, in way of the attachment of fittings or equipment in sandwich structures, is to be such that the induced loads can be transmitted into the surrounding structure by bending as opposed to shear. The areas are, in general, to take the form of suitably reinforced single skin areas, *see* Ch 3,3.14, with the additional layers of reinforcement staggered out onto the surrounding inner and outer skins as indicated in Fig. 3.3.1.

Volume 6, Part 8, Chapter 3

Scantling Determination for Mono-Hull Craft

Effective date 1 July, 2012

■ *Section 1*
General

1.2 General

1.2.3 In the absence of suitable test data, the mechanical properties of the materials is to be estimated from the appropriate procedures and formulae contained within this Part. The acceptable design values for glass reinforced polyester resin laminates are, in general, not to be taken greater than those determined from Tables 3.1.1 ~~and 3.1.2~~ to 3.1.3. Additional information on the application of the various formulae is given in Lloyd's Register's (hereinafter referred to as 'LR') *Guidance Notes for Calculation Procedures for Composite Construction*.

Table 3.1.1 Mechanical properties for chopped strand mat (CSM) ~~reinforcements~~ glass reinforced polyester resin laminates

Mechanical property	N/mm^2
Ultimate tensile strength	200~~G_e~~ f_c + 25
Tensile modulus	(15~~G_e~~ f_c + 2) x 10^3
Ultimate compressive strength	150~~G_e~~ f_c + 72
Compressive modulus	(40~~G_e~~ f_c – 6) x 10^3
Ultimate shear strength	80~~G_e~~ f_c + 38
Shear modulus	(1,7~~G_e~~ f_c + 2,24) x 10^3
Ultimate flexural strength	502~~G_e^2~~ f_c^2 + 106,8
Flexural modulus	(33,4~~G_e^2~~ f_c^2 + 2,2) x 10^3
NOTE ~~G_e~~ f_c is as defined in ~~1.2.6~~ 1.5.1.	

1.2.4 In the absence of suitable test data, the mechanical properties of aramid and carbon reinforced epoxy resin laminates are, in general, not to be taken greater than those determined from Tables 3.1.4 to 3.1.7.

~~*1.2.4*~~ *1.2.5* The various formulae referred to in 1.2.3 and 1.2.4 require that sufficient input data be available which relates to each of the proposed materials. The designers and/or Builders are to, in general, agree the values for use in the scantling analysis with LR at the design stage and prior to the submission of plans and data for appraisal.

Table 3.1.2 Mechanical properties for woven roving (WR) and cross-plied (CP) ~~reinforcements~~ glass reinforced polyester resin laminates at 0/90° degree orientation

Mechanical property	N/mm^2
Ultimate tensile strength	400~~G_e~~ f_c – 10
Tensile modulus	(30~~G_e~~ f_c – 0,5) x 10^3
Ultimate compressive strength	150~~G_e~~ f_c + 72
Compressive modulus	(40~~G_e~~ f_c – 6) x 10^3
Ultimate shear strength	80~~G_e~~ f_c + 38
Shear modulus	(1,7~~G_e~~ f_c + 2,24) x 10^3
Ultimate flexural strength	502~~G_e^2~~ f_c^2 + 106,8
Flexural modulus	(33,4~~G_e^2~~ f_c^2 + 2,2) x 10^3
NOTE ~~G_e~~ f_c is as defined in ~~1.2.6~~ 1.5.1.	

~~*1.2.6* Uni-directional reinforcements, the tensile properties of uni-directional laminates, consisting of E-glass and polyester resin, are to be determined from the procedures contained within this Part. Acceptable design values are, in general, not to be greater than those determined from the following:~~

~~Ultimate tensile strength (UDR)~~
~~= 1800G_e^2 – 1400G_e + 510 N/mm^2~~
~~Tensile modulus (UDR)~~
~~= (130G_e^2 – 104G_e + 39) x 10^3 N/mm^2~~

~~where G_e is the glass content by weight of the reinforcement within the laminate.~~

Table 3.1.3 Mechanical properties for uni-directional glass reinforced polyester resin laminates at 0/90° degree orientation

Mechanical property	N/mm^2
Longitudinal elastic modulus	$(50{,}5f_c - 6{,}87) \times 10^3$
Transverse elastic modulus	$(19{,}6f_c^2 - 15{,}7f_c + 6{,}6) \times 10^3$
In-plane shear modulus	$(7{,}3f_c^2 - 5{,}9f_c + 2{,}4) \times 10^3$
Longitudinal tensile strength	$656f_c - 89{,}3$
Longitudinal compressive strength	$530f_c - 72{,}1$
Transverse tensile strength	$68{,}4f_c^2 - 55f_c + 23$
Transverse compressive strength	$196f_c^2 - 157f_c + 65{,}6$
In-plane shear strength	$73{,}4f_c^2 - 59{,}2f_c + 24{,}5$

NOTES
1. f_c is as defined in 1.5.1.
2. Range of applicability: $0{,}4 < f_c < 0{,}7$. Laminates with fibre contents outside range of applicability will be specially considered.

Table 3.1.4 Mechanical properties for uni-directional aramid reinforced epoxy resin laminates at 0/90° degree orientation

Mechanical property	N/mm^2
Longitudinal elastic modulus	$(91{,}2f_c + 1{,}1) \times 10^3$
Transverse elastic modulus	$(1{,}5f_c + 2{,}4) \times 10^3$
In-plane shear modulus	$(8{,}6f_c^2 - 6{,}1f_c + 2{,}6) \times 10^3$
Longitudinal tensile strength	$1186f_c + 14{,}3$
Longitudinal compressive strength	$319f_c + 3{,}8$
Transverse tensile strength	$7{,}5f_c + 12{,}1$
Transverse compressive strength	$22{,}4f_c + 36{,}4$
In-plane shear strength	$129f_c^2 - 92f_c + 38{,}4$

NOTES
1. f_c is as defined in 1.5.1.
2. Range of applicability: $0{,}25 < f_c < 0{,}55$. Laminates with fibre contents outside range of applicability will be specially considered.

Table 3.1.5 Mechanical properties for woven roving (WR) and cross-plied (CP) aramid reinforced epoxy resin laminates at 0/90° degree orientation

Mechanical property	N/mm^2
Elastic modulus	$(46{,}4 f_c + 1{,}76) \times 10^3$
In-plane shear modulus	$(8{,}6 f_c^2 - 6{,}1 f_c + 2{,}6) \times 10^3$
Tensile strength	$596 f_c + 13{,}2$
Compressive strength	$171 f_c + 20{,}1$
In-plane shear strength	$129 f_c^2 - 92 f_c + 38{,}4$

NOTES
1. f_c is as defined in 1.5.1.
2. Range of applicability: $0{,}25 < f_c < 0{,}55$. Laminates with fibre content outside range of applicability will be specially considered.

Table 3.1.6 Mechanical properties for uni-directional carbon reinforced epoxy resin laminates at 0/90° degree orientation

Mechanical property	N/mm^2
Longitudinal elastic modulus	$(153f_c - 9{,}80) \times 10^3$
Transverse elastic modulus	$(5{,}8f_c^2 - 2{,}6f_c + 3{,}5) \times 10^3$
In-plane shear modulus	$(8{,}9f_c^2 - 6{,}6f_c + 2{,}7) \times 10^3$
Longitudinal tensile strength	$1377f_c - 88{,}2$
Longitudinal compressive strength	$842f_c - 53{,}9$
Transverse tensile strength	$21{,}7f_c + 7{,}5$
Transverse compressive strength	$65{,}2f_c + 22{,}4$
In-plane shear strength	$132f_c^2 - 99{,}5f_c + 40$

NOTES
1. f_c is as defined in 1.5.1.
2. Range of applicability: $0{,}3 < f_c < 0{,}6$. Laminates with fibre content outside range of applicability will be specially considered.

Table 3.1.7 Mechanical properties for woven roving (WR) and cross-plied (CP) carbon reinforced epoxy resin laminates at 0/90° degree orientation

Mechanical property	N/mm^2
Elastic modulus	$(78{,}7f_c - 4{,}15) \times 10^3$
In-plane shear modulus	$(8{,}8f_c^2 - 6{,}6f_c + 2{,}7) \times 10^3$
Tensile strength	$690f_c - 35{,}3$
Compressive strength	$453f_c - 15{,}7$
In-plane shear strength	$132f_c^2 - 99{,}5f_c + 40$

NOTES
1. f_c is as defined in 1.5.1.
2. Range of applicability: $0{,}3 < f_c < 0.6$. Laminates with fibre content outside range of applicability will be specially considered.

Existing Tables 3.1.3 *to* 3.1.5 *have been renumbered* 3.1.8 *to* 3.1.10.

1.5 Symbols and definitions

(*Part only shown*)

1.5.1 The symbols used in this Chapter, unless specified otherwise, are defined as follows:

f_c = the fibre content, by weight, within the laminate

1.13 Mechanical properties sandwich laminates

~~*1.13.11* Where shear ties are to be fitted, the maximum spacing between the shear ties is to be not greater than the maximum panel breadth that can be achieved with the basic core material. Shear ties are also, in general, to be fitted in the sandwich structure beneath primary longitudinal members.~~

~~*1.13.12* Shear ties fitted between the sandwich skins are to be angled at 45°. The width of shear tie bonding to the sandwich skins is to be 2,5tc or 50 mm whichever is the greater, see Fig. 3.1.3.~~

~~*1.13.13* Shear ties may also be fitted between the webs of deep floors, transverses, girders and other primary stiffening members of top hat type section. Such shear ties are to be spaced in accordance with the requirements of 1.16.2 and are to have a thickness of tw/3 or 2 mm whichever is the greater, see also Ch 2,5.19.1 and LR's *Guidance Notes for Structural Detail*.~~

Existing paragraphs 1.13.14 *to* 1.13.16 *have been renumbered* 1.13.11 *to* 1.13.13.

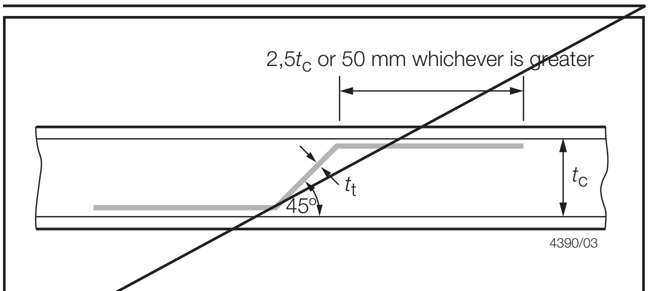


Fig. 3.1.3 Arrangement of shear ties

1.20 Plywood

1.20.2 The mechanical properties of the plywood proposed for use in structural applications is to be obtained from the plywood manufacturer and submitted for consideration. In the absence of such data ~~LR will estimate~~ the mechanical properties ~~based upon the recognised minimum expected strengths for the particular materials~~ can be determined from Tables 3.1.11 and 3.1.12.

Table 3.1.11 Mechanical properties for plywood panels

Mechanical property	N/mm^2
Flexural modulus parallel to face grain, $E_{//}$	$(34{,}1N^2 - 985N + 14800)\,\frac{\rho_{WD}}{1000}$
Flexural modulus perpendicular to face grain, $E_{\perp}$	$(-31{,}5N^2 + 909N - 633)\,\frac{\rho_{WD}}{1000}$
Flexural strength parallel to face grain, $\sigma_{//}$	$(0{,}15N^2 - 4{,}52N + 79{,}5)\,\frac{\rho_{WD}}{1000}$
Flexural strength perpendicular to face grain, $\sigma_{\perp}$	$(-0{,}1N^2 + 2{,}88N + 18{,}5)\,\frac{\rho_{WD}}{1000}$

NOTES
1. N is the number of plies and is an odd number between 3 and 15.
2. ρ_{WD} is the density of plywood in kg/m^3.

Table 3.1.12 Mechanical properties for plywood on edge

Mechanical property	N/mm^2
Flexural modulus parallel to face grain, $E_{//}$	$E_{//} = (15{,}6N^2 - 400N + 9850)\,\dfrac{\rho_{WD}}{1000}$
Flexural modulus perpendicular to face grain, $E_{\perp}$	$E_{\perp} = (-15{,}6N^2 + 400N + 3880)\,\dfrac{\rho_{WD}}{1000}$
Flexural modulus at any intermediate angle, E_{θ}	$E_{\theta} = E_{//}\cos^4\theta + 4G_{IP}\cos^2\theta\sin^2\theta + E_{\perp}\sin^4\theta$
Flexural strength parallel to face grain, $\sigma_{//}$	$\sigma_{//} = (0{,}093N^2 - 2{,}4N + 58{,}2)\,\dfrac{\rho_{WD}}{1000}$
Flexural strength perpendicular to face grain, $\sigma_{\perp}$	$\sigma_{\perp} = (-0{,}093N^2 + 2{,}4N + 22{,}4)\,\dfrac{\rho_{WD}}{1000}$
Flexural strength at any intermediate angle, σ_{θ}	$\sigma_{\theta} = \left(\dfrac{\cos^4\theta}{\sigma_{//}^2} + \dfrac{\cos^2\theta\sin^2\theta}{\sigma_{//}^2\,\tau^2}(\sigma_{//}^2 - \tau^2) + \dfrac{\sin^4\theta}{\sigma_{\perp}^2}\right)^{-1/2}$
In-plane shear modulus parallel/perpendicular to face grain, G_{IP}	$G_{IP} = 0{,}9\rho_{WD}$
In-plane shear modulus at any intermediate angle, G_{θ}	$G_{\theta} = (E_{//} + E_{\perp} - 2G_{IP})\cos^2\theta\sin^2\theta + G_{IP}(\cos^4\theta + \sin^4\theta)$
In-plane shear strength parallel/perpendicular to face grain, τ_{IP}	$\tau_{IP} = 0{,}015\rho_{WD}$
In-plane shear strength at any intermediate angle, τ_{θ}	$\tau_{\theta} = \left[\cos^2\theta\sin^2\theta\left(\dfrac{8}{\sigma_{//}^2} + \dfrac{4}{\sigma_{\perp}^2}\right) + \dfrac{(\cos^2\theta - \sin^2\theta)^2}{\tau_{IP}^2}\right]^{-1/2}$

NOTES
1. N is the number of plies and is an odd number between 3 and 15.
2. ρ_{WD} is the density of plywood in kg/m^3.

■ *Section 2*
Minimum thickness requirements

2.3 Sandwich skin laminate

2.3.1 The minimum ~~thicknesses of~~ amount of reinforcement in single skin laminates which form the inner and outer skins of sandwich panels are as indicated in ~~the appropriate Sections~~ 2.5.1. Where the structural requirements for thickness of either the bottom shell outer skin, or inner skin in way of an integral tank, is less than ~~4,5 mm, the acceptance of thicknesses down to a minimum of 3,5 mm will be subject to~~ that required by 2.5.1, a 20 per cent reduction in the minimum amount of reinforcement will be acceptable, conditional upon a vacuum test to demonstrate the watertight integrity and also an impact test for impact resistance of the laminate, *see* ~~2.8.2~~ 2.9.2.

2.4 Laminate thickness of single ~~and sandwich~~ skin laminates

2.4.1 The Rule minimum skin thicknesses for single skin laminates as determined from the appropriate Sections of the Rules are to be corrected for craft type irrespective of the reinforcement being used; the corrected minimum skin thickness of side, bottom, transom, wet-deck, vehicle deck and weather decks is to be determined from:

Single skin laminates:
$t_T = \omega\, t_{min}$
~~Sandwich skin laminates:~~
~~t_{min} = 2ω~~

where
ω = Service Type Correction Factor given in Table 3.2.1
t_T = Rule minimum thickness corrected for craft type, in mm
t_{min} = Rule basic minimum laminate thickness, in mm.

2.4.2 All minimum thicknesses of laminate for both stiffener and single skin laminate components are based on an assumed fibre content, f_c, of 0,5. Where the fibre content by weight, f_c, is less than 0,5, the required minimum thicknesses are to be determined from:

t_{fc} = $t_{0,5}$ (1,65 – 1,3f_c) mm

where

t_{fc} = minimum thickness at actual laminate fibre content, in mm

$t_{0,5}$ = Rule basic minimum laminate thickness at fibre content, by weight, of 0,5.

2.5 Minimum skin reinforcement in sandwich laminates

2.5.1 The minimum amount of reinforcement in single skin laminates, which form the inner and outer skins of sandwich laminates, is given in Table 3.2.2. The minimum amount of reinforcement is to be modified in accordance with 2.5.2 to 2.5.4.

2.5.2 The Rule minimum amount of reinforcement in 2.5.1 is to be corrected for craft type, irrespective of the reinforcement being used; the corrected minimum amount of reinforcement in the side, bottom, transom, wet-deck, vehicle deck and weather decks is to be determined from:

W_T = ωW_{min}

where

W_T = Rule minimum amount of reinforcement corrected for craft type, in g/m^2

W_{min} = minimum amount of reinforcement given in Table 3.2.2

ω = Service Type Correction Factor given in Table 3.2.1.

2.5.3 The Rule minimum amount of reinforcement in Table 2.5.1 is to be corrected for craft length, irrespective of the reinforcement being used; the corrected amount of reinforcement is to be determined from:

W_{Lc} = $K_L W_{min}$

where

W_{Lc} = Rule minimum amount of reinforcement corrected for craft length

W_{min} = minimum amount of reinforcement given in Table 3.2.2

K_L = craft length correction factor

= 1,0 – f_{LS} for $L_R \leq 15$ m

= 1,0 for $L_R \geq 35$ m

Intermediate values of K_L are to be determined by linear interpolation

f_{LS} = sandwich skin length factor given in Table 3.2.2 for mono-hull craft and Table 4.2.1 in Chapter 4 for multi-hull craft

= 0,0 for all sandwich panels in cargo, pilot and workboat crafts

L_R = Rule length, in metres, as defined in Pt 3, Ch 1,6.2.

2.5.4 The minimum amount of reinforcement is based on an assumed fibre content, f_c, of 0,5. Where the fibre content by weight, f_c, is greater than 0,5, the required minimum amount of reinforcement is to be determined from:

W_{fc} = $K_V W_{0,5}$

where

W_{fc} = minimum amount of reinforcement at actual laminate fibre content, in g/m^2

$W_{0,5}$ = Rule minimum amount of reinforcement laminate thickness at fibre content, by weight, of 0,5, in g/m^2

K_V = fibre volume correction factor for laminates with fibre content, by weight, greater than 0,5

$$= \left(\frac{1 + \frac{\zeta_F}{\zeta_R}}{1 + \left(\frac{\zeta_F}{\zeta_R}\right)\left(\frac{1 - f_c}{f_c}\right)} \right)^{0,67}$$

f_c, ζ_F and ζ_R are as defined in 1.5.1.

2.5.5 In areas where impact loads are not likely to occur, special consideration will be given to laminates with amount of reinforcement less than that required by 2.5.1, provided that all of the structural strength requirements of the Rules are complied with.

Table 3.2.2 Minimum amount of reinforcement in sandwich laminate skins

Panel location	Minimum amount of reinforcement, W_{min} (g/m^2)		Sandwich skin length factor, f_{LS}
	Glass	Carbon/ Aramid	
Integral tanks, fluid barrier skin	3650	2700	0,0
Hull bottom, outer skin	3650	2700	0,33
Hull bottom, inner skin	2850	2100	0,33
Side shell, outer skin	3250	2400	0,33
Side shell, inner skin	2450	1950	0,33
Inner bottom, outer skin	3650	2700	0,33
Inner bottom, inner skin	2850	2100	0,33
Double bottom plate floor	1650	1300	0,0
Watertight bulkhead	1650	1300	0,0
Deep tanks, exterior skin	2450	1950	0,0
Deep tanks, fluid barrier skin	3250	2400	0,0
Strength/weather deck, outer skin	2450	1950	0,33
Strength/weather deck, inner skin	1650	1300	0,0
Lower deck/within deckhouse, accommodation decks	1650	1300	0,0
Cargo deck, outer skin	2450	1950	0,0
Cargo deck, inner skin	1650	1300	0,0
Superstructure sides	1650	1300	0,0
Superstructure front	2050	1500	0,0
Superstructure aft	1650	1300	0,0
Superstructure top	1650	1300	0,0
Coach roof	1650	1300	0,0
Machinery casings	2050	1500	0,0
Bulwarks	1650	1300	0,0

NOTE
The minimum amount of reinforcement in hybrid laminates will be individually considered on an equivalence basis. *See* 2.9.2.

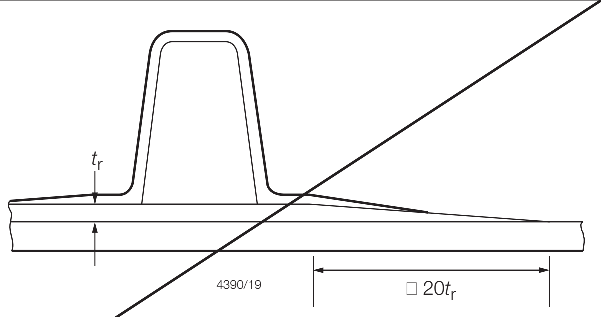
~~2.5~~ 2.6 Integral tank structure

~~*2.5.2*~~ *2.6.2* Where the boundaries of integral oil fuel and water tanks are of sandwich skin construction, the minimum ~~thickness of~~ amount of reinforcement in the laminate providing the fluid barrier, without satisfactory material testing, is to ~~be not less than 4,5 mm~~ comply with the requirements of 2.5.1, *see* 2.3.1.

~~2.6 Local reinforcement~~

~~*2.6.1* The hull and deck are to be locally increased in thickness in way of fittings for rudder tubes, propeller brackets, passenger routes, vehicle lanes, etc. The increase in thickness is to be not less than 50 per cent of the thickness of the adjacent plate laminate. Details of such reinforcement are to be submitted for consideration, *see also* Ch 2,3.9.~~

~~*2.6.2* Local reinforcement is in general to extend under the adjacent supporting structure and then be tapered gradually to the base laminate thickness over a distance not less than 20 times the difference in thickness, *see* Fig. 3.2.1.~~



~~**Fig. 3.2.1 Arrangement of local reinforcement**~~

~~*2.6.3* The amount of material laid 'wet on wet' is to be limited to avoid excessive heat generation.~~

~~*2.6.4* Where a superstructure is fitted, the side shell plating, in way of the end of the superstructure, may be required to be increased in thickness.~~

2.9 Sheathing

2.9.1 Areas of shell and deck which are subject to additional wear by abrasion, e.g. passenger routes, working areas of fishing craft, forefoot region, etc, are to be suitably protected by local reinforcement as given in 3.14 or sheathing. This sheathing may be of timber, rubber, steel, additional layers of reinforcement, etc, as appropriate. Details of such sheathing and the method of attachment are to be indicated on the relevant construction plans submitted for appraisal.

■ *Section 3*
Shell envelope laminate

3.4 Bottom

3.4.5 ~~In no case are the minimum thicknesses of laminate which form the skins of a sandwich laminate to be taken as less than 4,5 mm and 3,5 mm for the outer and inner skins respectively, *see also* 2.3.1~~. The amount of reinforcement in laminates which form the skins of a sandwich laminate is to comply with the requirements of 2.5.1, *see* 2.3.1.

3.5 Side

3.5.5 ~~In no case are the minimum thicknesses of laminate which form the skins of a sandwich laminate to be taken as less than 4 mm and 3 mm for the outer and inner skins respectively.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

3.6 Sheerstrake

3.6.1 The sheerstrake is in general to be taken as the side shell, locally reinforced in way of deck/hull connection and fender attachment. The amount of local reinforcement will be dependent upon the arrangement of structure and the proposed service, but is not to be less than that required by ~~2.6~~ 3.14.

3.14 Local reinforcement

3.14.1 The hull ~~is~~ and deck are to be locally increased in thickness in way of fittings for rudder tubes, propeller brackets, passenger routes, vehicle lanes, etc. The amount of increase is to be not less than 50 per cent of the adjacent plate laminate. Details of such reinforcement are to be submitted.

3.14.2 Local reinforcement is in general to extend under the adjacent supporting structure and then be tapered gradually to the base laminate thickness over a distance of not less than 20 times the difference in thickness, *see* ~~2.6~~ Fig. 3.3.3.

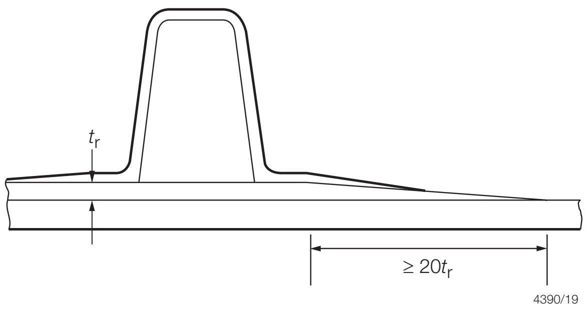


Fig. 3.3.3 Arrangement of local reinforcement

3.14.3 The amount of material laid ‘wet on wet’ is to be limited to avoid excessive heat generation.

3.15 Hull laminate arrangement

3.15.1 The hulls of all craft with a service speed of 25 knots or greater are to be moulded, such that following local impact, damage progressive stripping of surface reinforcements will not occur. This may be achieved by arranging all hull reinforcements as shown in ~~Fig. 3.3.3~~ Fig. 3.3.4.

Existing Fig. 3.3.3 *has been renumbered* Fig. 3.3.4.

Section 4

Shell envelope framing

4.19 Fenders and reinforcement in way

4.19.5 **Pilot craft** are, in general, to be fitted with large knees in way of the sheerstrake in areas as indicated in 3.6.5. The knees are to be aligned between the transverse frames and the deck beams. ~~In the case of longitudinally framed craft, intermediate web frames with knees are to be fitted at a spacing of generally not greater than 500 mm. A side longitudinal with a section modulus of in general, twice that of the Rule longitudinal for the web frame spacing is to be positioned just below the lower fendering to carry the load associated with the dynamic loading from pitching and rolling. Consideration is also to be given to the termination of such brackets by use of a ‘soft toe’ in way of the deck.~~ The thickness of the webs for these knees is to be twice that required by 1.16 or 6 mm at a fibre content by weight, of 0,5. Where the fibre content is less than 0,5 the minimum thickness is to be increased by the factor k_c as follows:

$t_{min} = 6k_c$

where

$k_c = 1{,}65 - 1{,}3f_c$

f_c is as defined in 1.5.1

In the case of longitudinally framed craft, web frames with knees are to be fitted at a spacing of generally no greater than 500 mm. A side longitudinal with a section modulus of, in general, twice that of the Rule longitudinal for the web frame spacing is to be positioned just below the lower fendering to carry the load associated with the dynamic loading from pitching and rolling. Consideration is also to be given to the termination of such brackets by use of a ‘soft-toe’ in way of the deck.

Section 5

Single bottom structure and appendages

5.2 Centreline girder

5.2.2 Centreline girders may be in the form of intercostal or continuous top hat or plate webs. Where the girder is intercostal, additional bracketing and local reinforcement as given in 3.14 are to be provided to maintain the continuity of structural strength. The face reinforcement in all cases is to be continuous.

Section 6
Double bottom structure

6.6 Plate floors

6.6.4 ~~The thickness of the plate laminates which form the skins for plate floors of sandwich skin construction are not to be taken as less than 2 mm~~. The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

6.9 Inner bottom laminate

6.9.6 ~~In no case are the minimum thicknesses of laminate which form the skins of a sandwich laminate to be taken as less than 4,5 mm and 3,5 mm for the outer and inner skins respectively~~. The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1, *see* 2.3.1.

Section 7
Bulkheads and deep tanks

7.3 Watertight bulkheads

7.3.6 ~~In no case is the minimum thickness of laminate which forms the skin of a sandwich laminate to be taken as less than 2 mm~~. The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

7.4 Deep tanks

7.4.6 ~~In no case is the minimum thickness of laminate which forms the skins of a sandwich laminate to be taken as less than 4 mm and 3 mm for the fluid barrier and exterior skins respectively, *see also* 2.5.2.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1, *see* 2.6.2.

7.16 Access

7.16.5 Where a manhole is fitted in a tank, the exposed edges of all openings cut in sandwich panels are to be suitably sealed. In general, a high density foam core (or equivalent material) is to be used around the perimeter of such openings. Exposed edges in way of cut-outs in sandwich panels are to be overlaminated with a weight of laminate not less than that required for the skin of the sandwich panel exposed to the fluid or ~~4,5 mm in thickness~~ as required by 2.5.1, whichever is the greater, *see* 2.3.1.

Section 8
Deck structures

8.3 Strength/weather deck laminate

8.3.5 ~~In no case are the minimum thicknesses of reinforcements which form the skins of a sandwich laminate to be taken as less than 3 mm and 2 mm for the outer and inner skins respectively.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

8.4 Lower deck/inside deckhouse deck laminate

8.4.5 ~~In no case is the minimum thickness of laminate which forms the skins of a sandwich laminate to be taken as less than 2 mm.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

8.6 Cargo deck laminate

8.6.5 ~~In no case is the minimum thickness of laminate which forms the skins of a sandwich laminate to be taken as less than 3 mm and 2 mm for the outer and inner skins respectively.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

8.12 Deck openings

8.12.6 For other shapes of corner, ~~local~~ reinforcement of the size and extent shown in Fig. 3.8.2 will, in general, be required. The required weight of reinforcement is to be not less than 25 per cent greater than the adjacent deck laminate.

~~**Fig. 3.8.2 Local reinforcement in way of hatch opening**~~

Fig. 3.8.2 Reinforcement in way of hatch opening

8.12.8 ~~Local reinforcement~~ Reinforcement as given in 8.12.6 will be required at lower decks in way of rapid change in hull form to compensate for loss of deck cross-sectional area. Otherwise, ~~local~~ reinforcement will not normally be required.

Section 9
Superstructures, deckhouses and bulwarks

9.1 General

9.1.8 Where a superstructure is fitted, the side shell plating, in way of the end of the superstructure, may be required to be increased in thickness, *see* 3.14.

9.3 House side laminates

9.3.5 ~~In no case is the minimum thickness of laminate which forms the skin of a sandwich laminate to be taken as less than 2 mm.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

9.4 House front laminates

9.4.5 ~~In no case is the minimum thickness of laminate which forms the skin of a sandwich laminate to be taken as less than 2,5 mm.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

9.5 House aft end laminates

9.5.5 ~~In no case is the minimum thickness of laminate which forms the skin of a sandwich laminate to be taken as less than 2 mm.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

9.6 House top laminates

9.6.5 ~~In no case is the minimum thickness of laminate which forms the skin of a sandwich laminate to be taken as less than 2 mm.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

9.7 Coachroof laminates

9.7.5 ~~In no case is the minimum thickness of laminate which forms the skin of a sandwich laminate to be taken as less than 2 mm.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

9.8 Machinery casing laminates

9.8.5 ~~In no case is the minimum thickness of laminate which forms the skin of a sandwich laminate to be taken as less than 2,5 mm.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

9.25 Bulwarks

9.25.6 ~~In no case is the minimum thickness of laminate which forms the skin of a sandwich laminate to be taken as less than 2 mm.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.5.1.

9.25.14 **Pilot craft** are to be fitted with ~~sufficient hand rails~~ a suitable hand rail system adjacent to the exposed areas of the working decks and platforms and in addition these areas should have non skid surfaces. Where permitted by the Flag Administration, a suitable approved continuous safety rail system will be acceptable. Suitable operating procedures are to be in place for the trained crew.

Volume 6, Part 8, Chapter 4
Scantling Determination for Multi-Hull Craft

Effective date 1 July, 2012

■ Section 2
Minimum thickness requirements

2.1 General

2.1.1 The minimum thickness requirements for single skin laminates are to be in accordance with Ch 3,2.

2.1.2 The minimum amount of reinforcement in single skin laminates which form the skins of sandwich laminate is to be in accordance with Ch 3,2. In addition, the minimum amount of reinforcement requirements of Table 4.2.1 are to be complied with. The amount of reinforcement is to be corrected for craft type, craft length and fibre content in accordance with Ch 3,2.5.

Existing paragraph 2.1.2 *has been renumbered* 2.1.3.

Table 4.2.1 Minimum amount of reinforcement in sandwich laminate skins

Panel location	Minimum amount of reinforcement, W_{min} (g/m^2)		Sandwich skin length factor, f_{LS}
	Glass	Carbon/ Aramid	
Bottom outboard, outer skin	3650	2700	0,33
Bottom outboard, inner skin	2850	2100	0,33
Side outboard, outer skin	3250	2400	0,33
Side outboard, inner skin	2450	1950	0,33
Wet-deck, outer skin	3250	2400	0,33
Wet-deck, inner skin	2450	1950	0,33
Cross-deck, outer skin	2450	1950	0,33
Cross-deck, inner skin	1650	1300	0,0

NOTE
The minimum amount of reinforcement in hybrid laminates will be individually considered on an equivalence basis. *See* Ch 3,2.9.2.

■ Section 3
Shell envelope laminate

3.3 Bottom outboard

3.3.6 ~~In no case are the minimum thicknesses of laminate which form the skins of a sandwich laminate to be taken as less than 4,5 mm and 3,5 mm for the outer and inner skins respectively.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.1.2.

3.5 Side outboard

3.5.7 ~~In no case are the minimum thicknesses of laminate which form the skins of a sandwich laminate to be taken as less than 4 mm and 3 mm for the outer and inner skins respectively.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.1.2.

3.7 Wet-deck

3.7.6 ~~In no case are the minimum thicknesses of laminate which form the skins of a sandwich laminate to be taken as less than 4 mm and 3 mm for the outer and inner skins respectively.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.1.2.

■ Section 5
Single bottom structure and appendages

5.3 Centre girder

5.3.2 Centreline girders may be formed with intercostal or continuous top hat or plate webs. Where girder webs are intercostal, additional bracketing and local reinforcement as given in Ch 3,3.14 are to be provided to maintain the continuity of structural strength. The face reinforcement in all cases is to be continuous.

■ Section 6
Double bottom structure

6.5 Plate floors

6.5.4 ~~The thickness of plate laminates which form the skins for plate floors of sandwich skin construction are in no case to be taken as less than 2 mm.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.1.2.

■ Section 8
Deck structures

8.4 Cross-deck laminate

8.4.5 ~~In no case are the minimum thicknesses of laminate which form the skins of a sandwich laminate to be taken as less than 3 mm and 2 mm for the outer and inner skins respectively.~~ The amount of reinforcement in laminates that form the skins of a sandwich laminate is to comply with the requirements of 2.1.2.

Volume 6, Part 8, Chapter 5

Special Features

Effective date 1 July, 2012

■ *Section 2*
Special features

2.9 Spray rails

2.9.4 Spray rails are to be supported by the internal stiffening arrangements and by additional local reinforcement as necessary, as given in Ch 3,3.14.

■ *Section 3*
Vehicle decks

3.1 General

3.1.5 The scantling requirements are based on structural strength and limitations on stress and deflection, with no allowance made for wear and tear. Local reinforcement as given in Ch 3,3.14 is to be fitted as necessary, particularly in way of vehicle lanes and passenger routes.

■ *Section 6*
Strengthening requirements for navigation in ice conditions

6.1 General

6.1.1 Where an ice class notation is to be included in the class of a craft, the scantlings will require special consideration, *see* Pt 3, Ch 2,9.

~~*6.1.1* The strengthening requirements detailed in this Section are applicable to craft, other than those assigned the notation **HSC** and/or **LDC** (*see* Pt 1, Ch 2), intended for operation in light first year ice conditions in areas other than the northern Baltic corresponding to unbroken level ice of thickness not greater than 0,4 m.~~

~~*6.1.2* Craft complying with the requirements of this Section, in addition to the requirements for sea-going service where applicable, will be eligible for the special features notation **Ice Class 1D**. Alternatively, a Special Duties Notation may be assigned indicating that the craft has been additionally strengthened for duties in ice, *see* Pt 1, Ch 2,3.8.3.~~

~~*6.1.3* Craft designed to operate in ice conditions other than those detailed in 6.1.1 are to comply with Part 8 of the Rules for Ships.~~

~~*6.1.4* The requirements of this Section are applicable to both longitudinally and transversely framed craft and concern the shell laminate and framing in the forward region, the stem, sternframe, rudder and the steering gear.~~

~~*6.1.5* The vertical extent of the ice strengthening is related to the ice light and ice load waterlines, which are defined in 6.2. The maximum and minimum Ice Class draughts at both the fore and aft ends will be stated on the Class Certificate.~~

~~*6.1.6* The requirements of this Section assume that when approaching ice-infested waters the craft's speed will be reduced appropriately. The vertical extent of ice strengthening for craft intended to operate in ice conditions at speeds exceeding 15 knots will be specially considered.~~

~~*6.1.7* The ballast capacity of propeller driven craft is to be sufficient to give adequate propeller immersion in all ice navigating conditions without trimming the craft in such a manner that the actual waterline at the bow is below the ice light waterline. Ballast tanks situated above the ice light waterline and adjacent to the shell, which are intended to be used in ice navigating conditions, are to be provided with heating pipes.~~

~~*6.1.8* Side scuttles are not to be situated in the ice belt.~~

~~6.2 Definitions~~

~~*6.2.1* The Ice Load Waterline is that corresponding to the Fresh Water Summer Loadline.~~

~~*6.2.2* The Ice Light Waterline is that corresponding to the lightest condition in which the craft is expected to navigate in ice.~~

~~*6.2.3* The Ice Load Waterline and the Ice Light Waterline are to be indicated on the plans. For navigation in certain geographical areas, the relevant National Authority may require the maximum Ice Class draught to be marked on the craft in a specified manner.~~

~~*6.2.4* The Main Ice Belt Zone extends vertically from 500 mm below the Ice Light Waterline to 400 mm above the Ice Load waterline and horizontally from the stem to 0,02L_R m aft of the point at which the deepest load waterline reaches its greatest breadth. L_R is as defined in Pt 3, Ch 1,6.2.1.~~

~~6.3 Powering of ice strengthened craft~~

~~*6.3.1* Ice strengthened craft are assumed to be capable of developing sufficient thrust to permit continuous mode icebreaking at a speed of at least five knots in ice having a thickness of 0,4 m and a snow cover of at least 0,3 m.~~

~~6.4~~ 6.2 Shell laminate

~~*6.4.1*~~ *6.2.1* It is assumed that single skin laminate construction incorporating longitudinal or transverse stiffening will be adopted. Where it is proposed to use sandwich skin construction, particular care is to be given to the selection of the core material; such proposals will require to be specially considered, and testing may be required to demonstrate the suitability of the panels.

~~*6.4.2*~~ *6.2.2* In way of the main ice belt zone, the thickness of the shell laminate is to be determined by direct calculation. A copy of these calculations is to be submitted for consideration.

~~*6.4.3*~~ *6.2.3* Changes in laminate thicknesses are to take place gradually, and in no case is the length of taper to be less than 20 times the difference in thickness. Additionally, individual ~~plys~~ plies of the laminate are to be arranged such that any delamination will be directed to the outer surface of the laminate.

~~*6.4.4* If the weather deck in any part of the craft is situated below the upper limit of the ice belt, the bulwark is to be reinforced to the same degree as the shell plating in the main ice belt.~~

~~6.5~~ 6.3 Shell framing

~~*6.5.1* Ice framing is to extend to a minimum distance of 1000 mm above the Ice Load Waterline and 1600 mm below the Ice Light Waterline between the stem and 0,02L_R m aft of the point at which the deepest load waterline reaches its greatest breadth. L_R is as defined in Pt 3, Ch 1,6.2.1.~~

~~*6.5.2*~~ *6.3.1* The web thickness for ice framing members of top-hat or plate section is to be determined by direct calculation. A copy of these calculations is to be submitted for consideration.

~~*6.5.3*~~ *6.3.2* Ice frames are to be attached to the shell plating by double primary bonding angles in accordance with Ch 3,1.18. The web area of ice frames is to be maintained; air and drain holes are to be kept to a minimum.

~~*6.5.4* Main and intermediate frames within the minimum extent of ice framing are to be efficiently supported to prevent tripping. The distance between anti-tripping supports is not to exceed 1000 mm.~~

~~*6.5.5*~~ *6.3.3* The bending moment assumed to be carried by the ice framing stiffening member is not to be taken as less than 50 per cent greater than that required by the appropriate Section of the Rules for the stiffening member subjected to hydrostatic or pitching pressure whichever is the greater.

~~6.6~~ 6.4 Stem construction

~~*6.6.1*~~ *6.4.1* The stem is to be additionally protected/reinforced by a metallic shoe or other equivalent arrangement. The shoe/reinforcement is to extend from the keel plate to 750 mm above the ice load waterline and is to be internally strengthened by closely spaced floors, brackets or webs. Details of such protection and the method of attachment are to be submitted for consideration.

~~*6.6.2*~~ *6.4.2* Attachment by mechanical means such as bolting or other methods is not to impair the watertight integrity of the craft. Through bolting of the hull is to be kept to a minimum and avoided where practicable.

~~6.7 Stern construction~~

~~*6.7.1* A transom stern is not normally to extend below the ice load waterline. Where this cannot be avoided, the transom is to be kept as narrow as possible and the scantlings of plating and stiffeners are to be as required for the midship region.~~

~~6.8 Bossings and shaft struts~~

~~*6.8.1* For craft with two or more propellers, shafting and sterntubes are generally to be enclosed within plated bossings. If detached supporting struts are necessary, their design, strengthening and attachment to the hull will be specially considered, *see also* Pt 3, Ch 3,3.4.~~

~~6.9 Rudder and steering arrangements~~

~~*6.9.1* Rudder posts, rudder horns, sole pieces, rudder stocks and pintles are to be dimensioned in accordance with Chapter 3 of the Rules for Materials. The speed used in the calculations is to be the service speed or 14 knots, whichever is the greater.~~

~~*6.9.2* The thickness of rudder plate laminate and webs is to be increased by 50 per cent over the requirements of Pt 3, Ch 3,2.~~

~~*6.9.3* Due regard is to be paid to the method of securing the rudder in the centreline position when backing into ice. Where possible, rudder stoppers working on the blade or rudder head are to be fitted.~~

~~*6.9.4* Where steering nozzles are fitted, the thickness of the shroud plating is, in general, to include an abrasion allowance of 20 per cent.~~

~~*6.9.5* The scantlings of the stock, pintles, gudgeon and sole pieces associated with the nozzle are to be increased on the basis given in 6.9.1. However, the diameter of the nozzle stock is to be not less than that calculated in the astern condition taking the astern speed as 7 knots or the actual astern speed, whichever is the greater.~~

~~*6.9.6* Nozzles with articulated flaps will be subject to special consideration.~~

Volume 7, Part 16, Chapter 2

Electrical Engineering

Effective date 1 July, 2012

■ *Section 11* Batteries

11.5 Ventilation

11.5.1 Battery compartments and boxes are to be ventilated to avoid accumulation of dangerous concentrations of flammable gas. ~~The ventilation openings are to be of a non-closeable type, with the exception of closing devices in accordance with 11.5.2, and a permanent notice is to be prominently displayed adjacent to them, stating:~~

> ~~THIS VENTILATOR OPENING IS NOT TO BE CLOSED OR BLOCKED AT ANY TIME – EXPLOSIVE GAS.~~

11.5.2 ~~Closing devices in battery compartment ventilation openings are to be provided with a means to be locked open. A permanent notice is to be prominently displayed adjacent to each one to make clear that the closing device is to be closed only in the event of a fire.~~ Where a battery compartment ventilator is required to be fitted with a closing device in accordance with Vol 3, Pt 3, Ch 4,11.4.1, a warning notice clearly stating the purpose of the closing device, for example, 'This closing device is to be kept open and only closed in the event of a fire or flooding – Explosive gas atmosphere', is to be provided at the closing device to mitigate the possibility of inadvertent closing of the ventilator. Furthermore, means to lock battery compartment ventilators in the open position are to be provided.

Cross-references

Section numbering in brackets reflects any Section renumbering necessitated by any of the Notices that update the current version of the Special Service Craft.

Part 8, Chapter 2

4.3.1	*References* 3.9.14 and 3.9.15 *have been deleted*

Part 8, Chapter 3

1.2.5	*Reference* Table 3.1.3 *now reads* Table 3.1.8
1.2.7	*Reference* Table 3.1.4 *now reads* Table 3.1.9
1.13.10	*See also* 1.13.11 *has been deleted*
1.13.15 ***(1.13.12)***	*Reference* 1.13.14 *now reads* 1.13.11
1.13.16 ***(1.13.13)***	*Reference* 1.13.14 *now reads* 1.13.11 *Reference* 1.13.15 *now reads* 1.13.12
1.14.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
1.14.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
1.14.5	*Reference* Table 3.1.5 *now reads* Table 3.1.10
3.15.1	*Reference* Fig. 3.3.3 *now reads* Fig. 3.3.4
4.4.4	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.5.4	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.6.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.7.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.8.3	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.9.4	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.10.4	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.11.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.12.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.13.3	*Reference* Table 3.1.5 *now reads* Table 3.1.10
6.10.4	*Reference* Table 3.1.5 *now reads* Table 3.1.10
6.11.3	*Reference* Table 3.1.5 *now reads* Table 3.1.10
7.3.8	*Reference* Table 3.1.5 *now reads* Table 3.1.10
7.4.6	*Reference* 2.5.2 *now reads* 2.6.2
7.4.8	*Reference* Table 3.1.5 *now reads* Table 3.1.10
8.8.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
8.8.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
8.9.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
8.11.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.10.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.10.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.11.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.11.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.12.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.12.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.13.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.13.3	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.14.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.14.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.15.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.15.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.16.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.16.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
9.25.7	*Reference* Table 3.1.5 *now reads* Table 3.1.10

Part 8, Chapter 4

3.2.3	*Reference to* Ch 3,2.6.2 now reads Ch 3,2.14.2
4.2.4	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.3.4	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.4.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.5.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.6.3	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.12.4	*Reference* Table 3.1.5 *now reads* *Table* 3.1.10
4.13.4	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.14.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.15.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.16.3	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.22.4	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.23.4	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.24.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.25.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10
4.26.3	*Reference* Table 3.1.5 *now reads* Table 3.1.10

8.5.1	*Reference* Table 3.1.5 *now reads* Table 3.1.10
8.5.2	*Reference* Table 3.1.5 *now reads* Table 3.1.10

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